A-P file

CALIFORNIA DIVISION OF MINES AND GEOLOGY

Supplement #1 to Fault Evaluation Report FER-12

January 18, 1978

1. Name of fault: Santa Ynez fault (south branch).

4. Additional references:

m. Envicom Corporation, 1978, Engineering geologic investigation of potentially active faults, Hollister Ranch, Santa Barbara County, California, Unpublished consulting report of 1/4/78, 8 p., with 1/4/78 report by R.J. Schlemon on soil stratigraphy, 3 p. (Attached reports describe trenches and dozer cuts in two areas: 1) At Alegria Canyon, the fault was identified as being at least as young as 10,000-35,000 years. Active colluvial creep prevents evaluation of Holocene faulting. 2) In Aqua Caliente Creek area, fault identified in Oligo-Miocene units, but not found in terrace deposits; more work recommended.)

n. Earth Sciences Associates, 1970, report for Hollister Ranch on Santa Ynez fault (south branch) (ESA would not release report when contacted in 1977, but Dick Hamilton (p.c., 1977) verified that evidence of late Quaternary faulting was found in vicinity of Alegria Canyon).

o. Current activities: 1) Dames and Moore actively evaluating fault re proposed pipeline (liquified natural gas?) from Pt. Conception to Los Angeles; 2) Orin Sage and Envicom (Asquith) hired by Hollister Homeowners Association (see (m) above): 3) James Slosson hired by

PUC to review pipeline proposal; 4) Roger Martin of CDMG (L.A. District) examined trenches briefly in December 1977; part of CDMG review group headed by Perry Amimoto).

8. Conclusion: The south branch of the Santa Ynez fault may have been active in Holocene time, although hard evidence is still lacking. Also, excavations in Canada del Agua Caliente did not locate fault in late Pleistocene terrace gravels, which raises questions as to the location or recency of faulting. Also, the bedrock relations at Agua Caliente indicate reverse or thrust faulting (north side up), whereas at Algria Canyon, the fault is steep with the north side down.

9. Recommendations: Do not zone until new data demonstrates that the fault is "sufficiently active" (Holocene) and "well-defined."

Earl W. Hart

EARL W. HART
Senior Geologist
January 18, 1978

File with FER-12

envicom corporation
PHYSICAL, ECOLOGICAL and SOCIAL SCIENCE CONSULTANTS

January 4, 1977

Dr. James E. Slosson
Engineering Geology Consultants, Inc.
14054 Victory Blvd.
Van Nuys, CA 91401

Dear Jim:

Enclosed, per your request, are copies of the report of our investigation of the south branch of the Santa Ynez fault and that of Dr. Roy Shlemon which was conducted at our request.

If you have any questions regarding this work, please call me.

Sincerely,

Donald O. Asquith
Vice President

pt

cc: Mr. George Allen
Dr. Roy Shlemon

4521 Sherman Oaks Avenue • Sherman Oaks, California 91403 • Telephone (213) 986-4203

envicom corporation
PHYSICAL, ECOLOGICAL and SOCIAL SCIENCE CONSULTANTS

January 4, 1978

Hollister Ranch Owner's Association
Santa Barbara, California

ATTN: Mr. George Allen
Mr. Dick LaRue

RE: Engineering Geologic Investigation of Potentially Active Faults, Hollister Ranch, Santa Barbara County, California

A. INTRODUCTION

At your request, we have conducted an engineering geologic investigation of potentially active faulting on the Ranch. As previously discussed, our preliminary investigation indicated that we should begin on the south branch of the Santa Ynez fault in Agua Caliente Canyon where the younger rocks and soils that could be used to establish the activity of this fault are best preserved. However, depending on the results obtained in this canyon, additional work in the adjacent Alegria Canyon was considered a possibility.

The work in Agua Caliente Canyon was conducted on November 14, 15 and 16 using a backhoe and a D-4 bulldozer. The work in Alegria Canyon was completed on December 13 and 14 with a D-6 bulldozer, as earlier attempts to excavate the necessary trenches with the D-4 were not successful. The trenches in Alegria Canyon were examined by Dr. Roy Shlemon on December 22, 1977. The results of these investigations follow.

B. AGUA CALIENTE CANYON

The primary effort in Agua Caliente Canyon consisted on backhoe trenching, dozer scraps, and hand-cleaning of existing exposures as shown on Figure 1 to further evaluate fault relationships in the bedrock, on the upper river terraces, and in the lower terrace materials exposed near creek level.

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1. Bedrock Relationships

Existing cuts along the dirt road in the southwestern part of the area (S-1 and S-2 on Figure 1) were further excavated to obtain fresh exposures of the fault in both bedrock and the overlying slope wash (colluvium). The following relationships were observed at these two localities:

a. The fault trends generally north 30° east and is inclined to the north at approximately 50-60°. Locally, however, the inclination of the fault plane is much lower, and is near-flat in parts of the exposure at S-2.

b. The fault exposes Alegria sandstone over Rincon shale indicating apparent reverse or left-lateral movement. Poorly developed striations in the clay on the fault plan indicate the most recent movement to be primarily reverse with the northwest side up (i.e., Alegria thrust over Rincon).

c. The fault does not cut the slope wash, the age of which is unknown.

2. Upper Terrace Relationships

Three backhoe trenches (T-1, T-2, T-3) were excavated in the upper terrace surface along the projected trend of the fault. Two of the trenches were located across topographic features, the alignment and character of which suggested possible fault scarps. While bedding was poorly developed to non-existent in the upper terrace deposits, relationships were sufficiently developed to establish that the surficial features are not fault scarps. Other than this, there was no evidence of faulting of the upper terrace, but on the other hand, faulting cannot be precluded because of the poorly developed bedding and homogeneous nature of these deposits.

3. Lower Terrace Relationships

Two dozer scrapes (S-3 and S-4 on Figure 1) were excavated in the lower terrace deposits along the expected trend of the fault. The primary objective of these excavations was an unusual bend in the creek at S-3 that could be

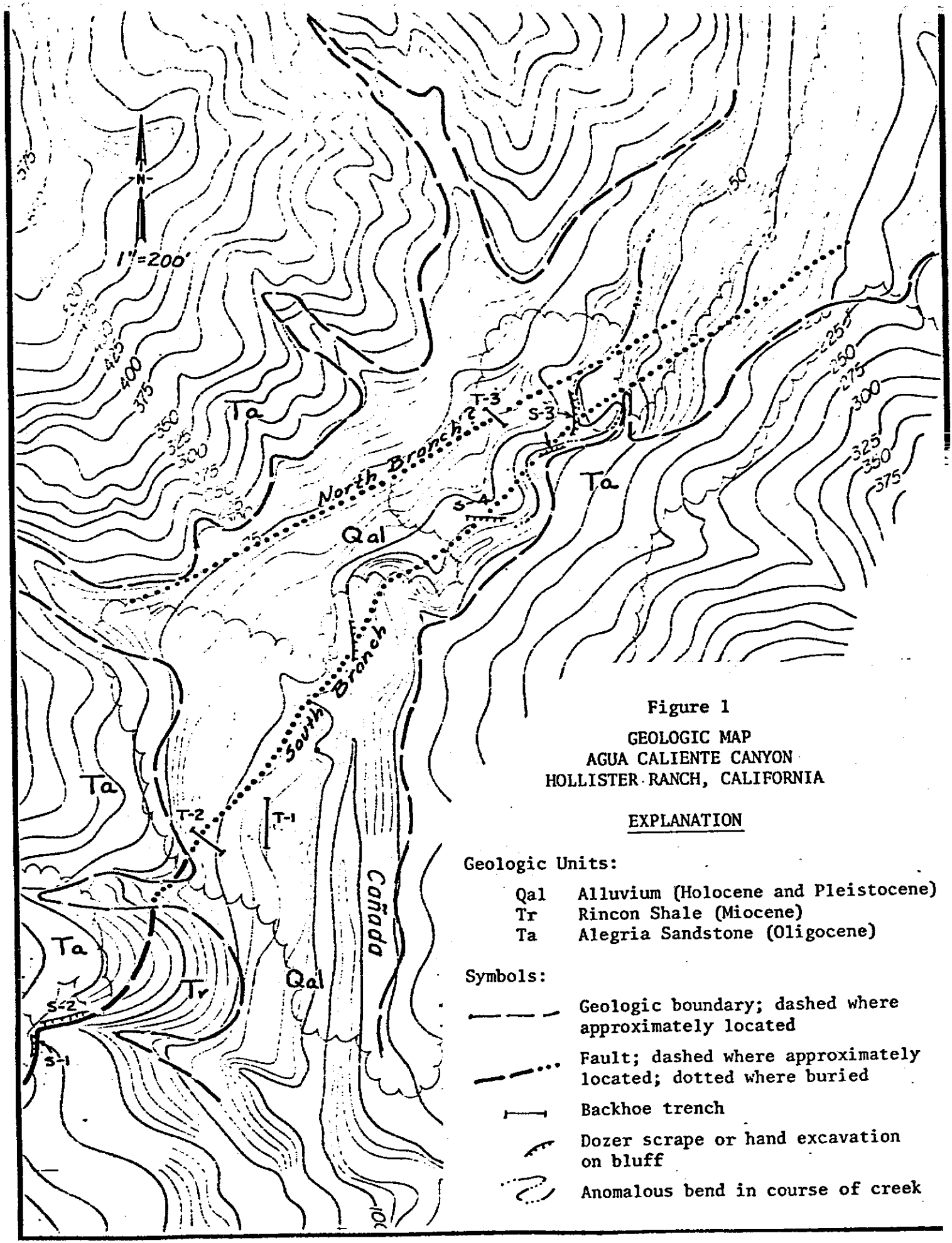

Figure 1

GEOLOGIC MAP
AGUA CALIENTE CANYON
HOLLISTER RANCH, CALIFORNIA

EXPLANATION

Geologic Units:

Qal	Alluvium (Holocene and Pleistocene)
Tr	Rincon Shale (Miocene)
Ta	Alegria Sandstone (Oligocene)

Symbols:

- Geologic boundary; dashed where approximately located
- Fault; dashed where approximately located; dotted where buried
- Backhoe trench
- Dozer scrape or hand excavation on bluff
- Anomalous bend in course of creek

the result of recent fault movement, but a faultlike feature exposed during cutting of the access road to S-3 was also investigated (S-4). The results of this work are summarized as follows

1. The lower terrace deposits are well bedded, and any fault offset could be detected if present.

2. The lower terrace deposits at the sharp bend (actually a sharp doubling back) of the creek are not faulted at or above creek level. If this unusual feature is related to recent faulting, the relationship is not apparent.

3. The fault-like feature in the access cut is actually the south bank of a channel that was previously located just north of the existing creek alignment in this area. Shallow exposures (3-4 feet) suggested possible faulting, but deeper cutting exposed relationships indicative of erosion and deposition along the older channel alignment.

4. The older channel configuration is such that the lower terrace deposits are probably older than the upper terrace surfaces and deposits.

C. ALEGRIA CANYON

The approximate location of the fault reported in the old dozer trench excavated by ESA in 1970 was re-excavated for a length of about 100 feet and to a depth of about 18 feet on the uphill side. In addition, a cut along the dirt road near the top of the ridge to the southwest of the ESA trench was cleaned out to better expose fault relationships, and a new trench was cut on the ridge between Alegria and Agua Caliente Canyons. The results of this trenching are summarized below.

1. Re-excavated Trench of ESA

The trench along the west bank of Alegria Canyon that was originally opened by ESA in 1970 as a part of their dam feasibility investigation was reopened so that fault relationships could be further examined. A geologic log of the

west side of the trench, at and near the fault plane, is included here as Figure 2. The principal conclusions from this exposure are as follows:

a. The colluvium in the uppermost 32-42 inches of the trench wall shows no evidence of fault movement. However, this material is located on a relatively steep slope (28^{o}) on which creep would be expected that would obliterate any evidence of recent faulting.

b. The materials below the colluvium have been cut by numerous episodes of faulting along a zone of shearing approximately one foot wide. These include 5 feet of terrace gravel on the southeast side of the fault and at least 14 feet of terrace silt, clay and gravel on the northwest side of the fault.

c. On the basis of their general appearance, these terrace materials are probably late Pleistocene in age, and may correlate with the marine terraces near the mouth of the Canyon. These terraces correlate generally with those near Goleta dated by the U.S. Geological Survey at about 40,000 years old.

d. The terrace materials on either side of the fault are quite different, indicating that the fault movement is not a simple up-down relationship. The thicker, finer-grained, and darker nature of the terrace material on the northwest side of the fault suggest that it may have been moved laterally from a more central location in the old channel to its present position on the side of the canyon.

2. Trench on West Ridge

The trench on the west ridge shows clear indications of faulting of soil and/or colluvial deposits to within 22 inches of the surface (Figure 3). The upper 3½ to 4 feet of soil, of which about 2 feet is in fault contact with bedrock, is softer and coarser grained than the lower 4½ to 5 feet of soil on the northwest side of the fault. Based on appearance and character of the materials, Dr. Shlemon concluded that a remnant of a soil horizon is present at a depth of two to three feet that is probably older than 10,000 years, but probably younger than 20-30,000 years. This soil is in fault contact with bedrock along the fault zone. The younger material above this soil is colluvium that is undergoing creep that would be expected to obliterate all but the most recent movements.

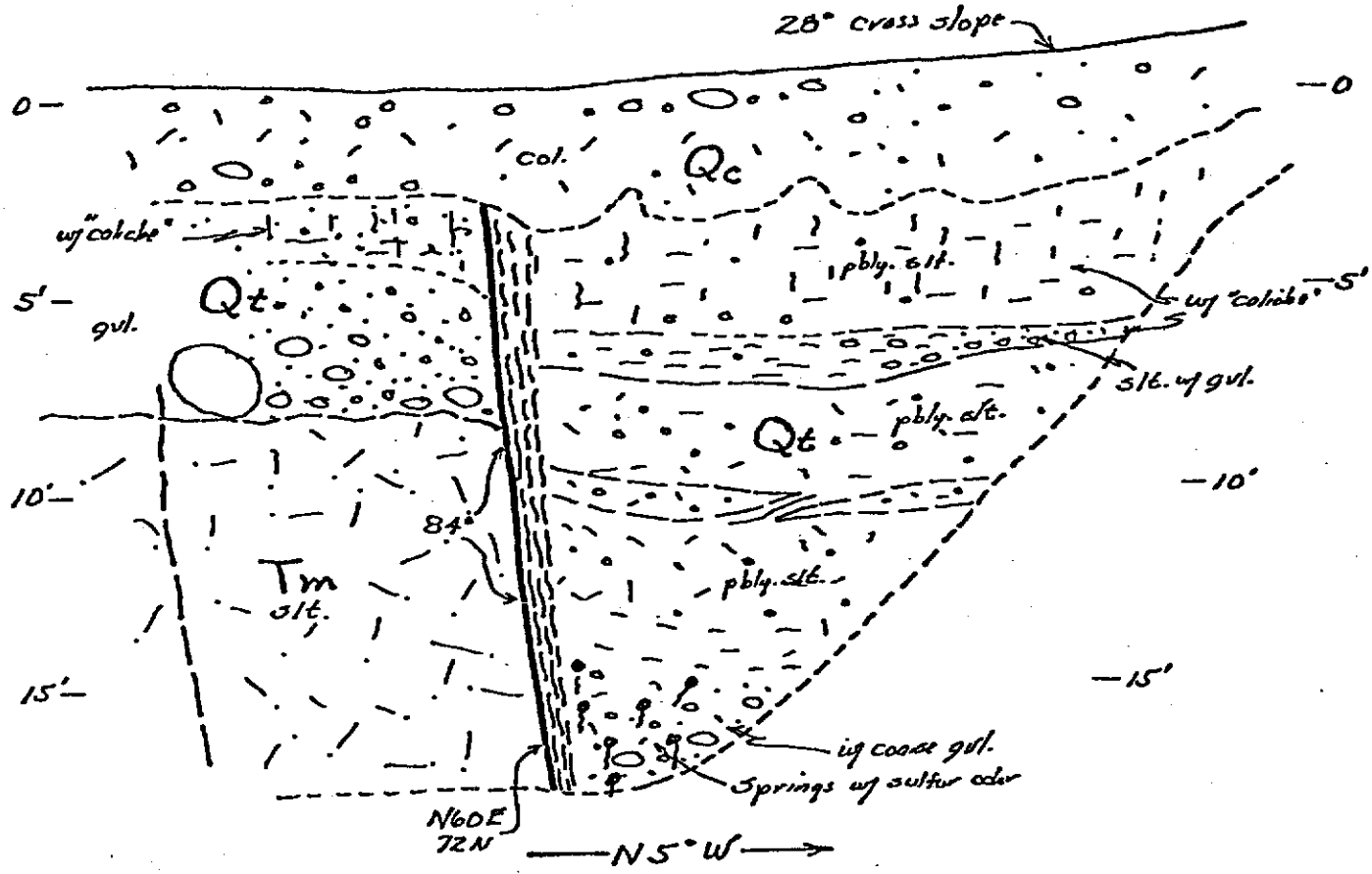

Figure 2. Log of west wall re-excavated trench in Alegria Canyon showing fault relationships between Monterey Shale (Tm), Quaternary terrace deposits (Qt) and colluvium (Qc).

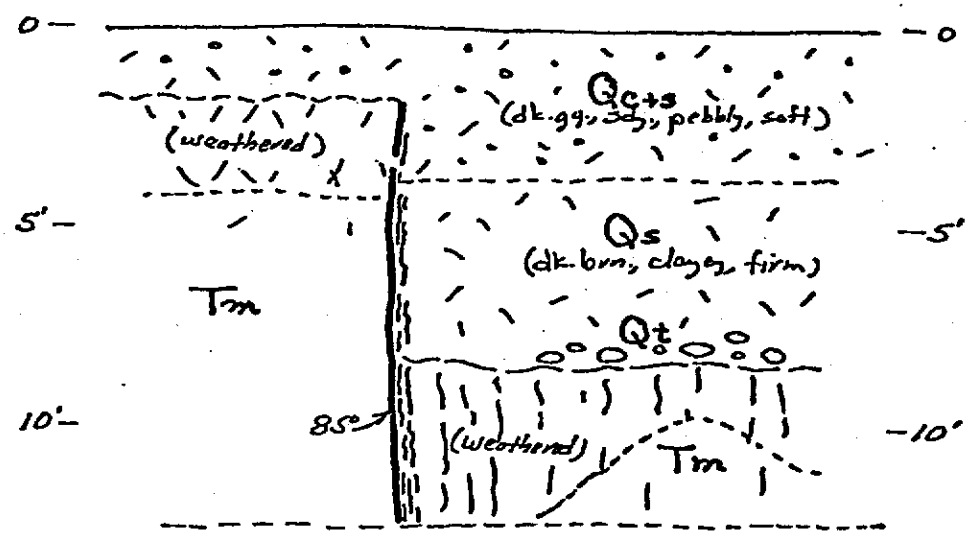

Figure 3. Log of southwest wall trench on ridge west of Alegria Canyon showing fault relationships between Monterey Shale (Tm), Quaternary terrace deposits (Qt) with overlying clayey soil (Qs), and younger soil and colluvium above (Qc + s).

3. Trench on East Ridge

The trench on the east ridge between Alegria and Agua Caliente Canyons located what is probably the main trace of the south branch of the Santa Ynez fault. The faulted bedrock (Rincon Shale) is overlain by 3-4 feet of residual soil and/or colluvium that shows no evidence of faulting. However, the bedrock/soil contact is irregular and locally gradational, and several inches of movement could have occurred at this contact and not be apparent in the trench wall.

C. CONCLUSIONS AND RECOMMENDATIONS

Investigations conducted to date indicate that:

1. The south branch of the Santa Ynez fault in Alegria Canyon shows evidence of numerous episodes of movement since deposition of the terrace materials that may have occurred as recently as 40,000 to 50,000 years ago.

2. Younger materials faulted include a remnant soil that is estimated on the basis of its appearance and character to be older than about 10,000 years and probably younger than 20,000 to 30,000 years.

3. Soil material younger than the above is colluvium on relatively steep slopes that is undergoing creep that would have obliterated any direct evidence of fault movement more recent than approximately 10,000 to 20,000 years ago.

Based on the above, we conclude that while no materials were exposed in Alegria Canyon that would be expected to provide direct evidence of Holocene activity, the evidence of numerous episodes of movement since approximately 40,000 to 50,000 years ago is sufficient to indicate that this fault may well have undergone Holocene movement. Deposits of the appropriate age to further resolve this question are best preserved in Agua Caliente Canyon, and additional investigations should concentrate on locating the fault beneath or in these deposits.

Respectfully submitted,

Donald O. Asquith, PhD.
Engineering Geologist, E.G. 913
Registered Geophysicist G.P. 86

Orrin Sage, Jr., PhD.

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Land Resources Evaluation
Economic Geomorphology
Quaternary Geology
Soil Stratigraphy

24 December 1977

Dr. Donald O. Asquith, Vice-President
Envicom Consultants
4521 Sherman Oaks Avenue
Sherman Oaks, California 91403

Dear Don:

Attached is a memo of observations pertaining to soil dating of the South Branch of the Santa Ynez Fault as exposed in two bulldozer trenches, and in streamcuts on the Hollister Ranch, Santa Barbara County. The conclusions, as we reviewed in the field, are judgments based on the rather long, but only one-day reconnaissance.

1. There is no positive evidence for fault displacement within the last 10,000 or 15,000 years. Conversely, however, movement may have occurred within this interval, for the apparently undisplaced surface horizon (mollic epipedon) is colluvial, highly bioturbated, and may be no more than several hundred years old.

2. There is evidence, albeit preliminary, of movement within the interval of about 10,000 or 15,000 to approximately 30,000 years ago. This evidence is mainly the displacement of a buried argillic horizon (IIBtb) preserved on the apparent downthrown side of the fault (north) as exposed in Trench # 1 (see memo for description).

3. The slopes at both Trench 1 and 2 are steep and typified by modern colluvial processes; the surface soils, at least, are thus unstable. A better trench location to minimize colluviation would be at the crest of the hill (drainage divide) about 20 feet higher than Trench # 1.

4. Agua Caliente Canyon is a better locality to date fault displacement by soil-stratigraphic techniques should the fault plane be clearly exposed. A discontinuous weathered gravel (C1 horizon), at least 25,000 years old and probably much older, is overlain by fluvial silts possibly containing one or more buried soils. However, extensive clearing of brush and local colluvium would be necessary to expose clearly the fault and sufficient late Quaternary sediments and soils for dating.

Don, thank you again for organizing the field work and for providing access to the Hollister Ranch.

With best regards,

Roy J. Shlemon

Roy J. Shlemon, Ph.D.

RJS: qgg

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Land Resources Evaluation
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Soil/Geomorphic Observations, December 22, 1977

South Branch, Santa Ynez Fault

Hollister Ranch, Santa Barbara County, California

The notes following pertain to a reconnaissance field assessment of the last time of displacement of the South Branch of the Santa Ynez Fault as exposed in two bulldozer trenches near Alegria Canyon, and in stream and roadcuts along Agua Caliente Creek on the Hollister Ranch. The bulldozer trench near the top of a ridge in Alegria Canyon is designated "number 1"; the trench near the base of the hill is deemed "number 2." The location and detailed logs of the trenches are not specifically indicated in this memo, but are available in reports compiled by Envicom Consultants, Sherman Oaks, California.

Bulldozer Trench Number 1 (ridge top) - Cañada de Alegria

Generalized Soil Profile Description - East-Facing Wall
On Apparent Down-thrown Side (North) of Fault

Horizon		Description
A	- 0-22 inches:	very dark grey (10YR 3/1) moist pebbly silty clay loam; weak fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine to medium roots; common fine tubular pores; disseminated lime increasing toward base of horizon; clear smooth lower boundary.
		Note: estimated 15-20 percent of horizon typified by 2-3 inch diameter krotovinas; surface lag gravels to 3-inch diameter.
IIBtb	- 22-45 inches:	greyish brown (10YR 5/2) heavy silty clay loam; very dark greyish brown (2.5Y 3/2) when moist; moderate, medium to coarse angular blocky structure; hard, friable, very sticky and plastic; common fine roots; few thin clay films on ped faces and common thin films line pores; disseminated lime and few fine to medium filaments and seams near base; gradual wavy lower boundary.
		Note: This horizon is a moderately-developed, argillic buried soil truncated near top. However, horizon still subject to contemporary pedogenesis indicated by frequency of modern root tubules, krotovinas, and organic and apparent manganese staining on ped faces.

Horizon -	Description (continued)
IIC - 45 to greater than 72 inches:	olive brown (2.5 4/2) to dark yellowish brown (10YR 4/3) fine sandy clay loam with clasts to 6-inches diameter of reworked (colluvial), angular very dark grey (2.5Y 3/0) organic blocks near top of horizon; contorted massive aggregates at top grading to weak, fine to medium subangular blocky structure near base; hard, firm, sticky and plastic; few to common fine roots; disseminated lime and common medium carbonate nodules above discontinuous clay lenses within horizon; diffuse, irregular lower boundary. Note: Upper part of horizon contains blocks of locally-derived colluvial organic (A-horizon) sediments. Increasing frequency of subangular gravels to 6-inches diameter define base of unit at approximate depth of 90 inches; apparent reworked marine terrace deposits on abrasion platform cut across Tertiary Monterey Formation.

Additional Observations, Bulldozer Trench # 1

1. Surface slope approximately 20-25 degrees, increasing toward base. Contemporary colluviation indicated by slope, soil flow structures, reworked and contorted remnants of buried A1 horizons.

2. A-horizon continuous and apparently unbroken across fault (upper 22 inches); but this is a zone of active colluviation, and high bioturbation (rootcasts, fillings, and krotovinas).

3. Salt, presumably NaCl, on ped faces of buried horizon (IIBtb) likely mobilizing clay movement (illuvial) and accelerating development of argillic horizon.

4. Few slickensides on ped faces of buried argillic horizon (IIBtb) internally generated by expansive clays (probably montmorillonite). Field classification of soil to Subgroup level: Vertic Haploxeroll.

5. Interpretation of soil age/fault displacement:

   A. Surface horizon (mollic epipedon) is modern and actively moving; no evidence for displacement, but not useful as time-stratigraphic marker.

   B. Buried argillic horizon (IIBtb) displaced by fault as exposed on east-facing trench cut. Insufficient exposure on west-facing cut for verification. Age of moderately developed horizon (based on clay content, structural development and illuvial clay films) deemed greater than 10,000 - 15,000 years, but probably younger than about 30,000 years. Additional fault/soil relationships needed in non-colluvial areas for more precise dating.

Bulldozer Trench Number 2 (base of hill) - Cañada de Alegria

1. Surface slope to 30 degrees; colluviation; lag gravels actively moving (to 6-inches diameter); mollic epipedon (A1 horizon) approximately 18-20 inches undisturbed across fault; stony fine sandy clay loam; dark yellowish brown (10YR 4/2) moist; clear wavy lower boundary.

2. More than 10-foot section of alternating organic clays (very dark grey - 2.5Y 3/0) and fine sandy and silt clay loam (yellowish brown - 10YR 5/2) on apparent downthrown side (north) of fault.

3. Carbonate nodules to 1/2-inch diameter in silts, and rinds to 1/4-inch thick on pebble bases perched on interbedded very plastic and very sticky clay. Some pedogenic carbonate indicated by filled root tubules; most related to local perched groundwater on organic clays.

4. Repeated sequence of organic clay and oxidized silts on north side of fault suggestive of multiple movement in order of 3-4 inches per displacement. But this is inference only and requires additional study on non-colluvial stratigraphic sections.

5. High degree and rate of colluviation at this exposure preclude using soil profile development to date last movement of fault; better expression in trench # 1.

Road and Stream-cuts - Cañada del Agua Caliente

1. No known exposure of fault trace as yet in this area.

2. Highly oxidized and weathered basal channel gravels (C1 horizon), at least 6 feet thick, exposed discontinuously in stream cuts. Unit is truncated by local sidestream fluvial and colluvial fill. Overlying mollic and argillic horizons unseen and presumably removed in an earlier "erosional cycle." However, weathering of remnant C1 horizon consistent with an age of greater than at least 25,000 - 30,000 years, and possibly much older.

3. Locally, an estimated 40-foot section of post-buried channel gravel, overbank and sidestream silt on west-facing stream cuts, is likely greater than at least 10,000 years based primarily on elevation above the modern channel. One or more buried soils (probably with cambic or incipient argillic horizon) may occur near top of section; but this requires field verification by soil description and sampling.

4. Summation: A late Quaternary stratigraphy is present in Cañada del Agua Caliente, but locally covered by colluvium on steeper slopes, and brush along much of the stream banks. Would require extensive "clean up" by bulldozer to (a) locate fault, and (b) expose sufficient sediments and soils for possible dating.